

PROJECT ADMINISTRATION DATA SHEET☒

ORIGINAL

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REVISION NO. _____

Project No. E-16-602DATE: 3/16/81Project Director: Warren C. Strahle School/Lab Aerospace EngineeringSponsor: National Science Foundation; Washington, D. C.Type Agreement: Grant No. CME-8022366 dated 2/19/81Award Period: From 2/1/81 To 6/30/82* 7/31/83 (Performance) 9/30/82 (Reports)Sponsor Amount: \$67,244 (First year funding only) Contracted through:Cost Sharing: \$5,952 (E-16-352) (First year only) GTRI/~~GIT~~Title: Pressure Velocity Correlation in Reacting Turbulent FlowsADMINISTRATIVE DATAOCA CONTACT Leamon R. Scott1) Sponsor Technical Contact: George K. Lea, National Science Foundation;
Washington, D. C. 205502) Sponsor Admin./Contractual Contact: Al Rice; National Science Foundation,
Washington, D.C. phone 202-357-9626Reports: See Deliverable Schedule Security Classification: N/ADefense Priority Rating: N/ARESTRICTIONSSee Attached NSF Supplemental Information Sheet for Additional RequirementsTravel: Foreign travel must have prior approval - Contact OCA in each case. Domestic travel requires sponsor approval where total will exceed greater of \$500 or 125% of approved proposal budget category.Equipment: Title vests with GITCOMMENTS: *entire period charges can be incurredCOPIES TO:Administrative Coordinator
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Other: _____

SPONSORED PROJECT TERMINATION/CLOSEOUT SHEETDate 10/12/83Project No. E-16-602School xxx Aerospace Engineering
xxxIncludes Subproject No.(s) NONEProject Director(s) Warren C. StrahleGTRI xxxSponsor National Science FoundationTitle: Pressure Velocity Correlation in Reacting Turbulent FlowsEffective Completion Date: 7/31/83 (Performance) _____ (Reports) _____

Grant/Contract Closeout Actions Remaining:

- ☒ None
- ☐ Final Invoice or Final Fiscal Report
- ☐ Closing Documents
- ☐ Final Report of Inventions
- ☐ Govt. Property Inventory & Related Certificate
- ☐ Classified Material Certificate
- ☐ Other _____

Continues Project No. _____

Continued by Project No. E-16-696

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PROGRESS REPORT

The program, as of this writing, has been underway for 21 months. Significant progress in theoretical and experimental work is as follows:

1. The first known measurement of the $\overline{p' v'}$ correlation in a reactive turbulent flow has been accomplished by intrusive measurements on a premixed jet flame. Simultaneous stagnation pressure, temperature, and heat transfer (velocity) measurements were performed in a small measurement volume at various stations along the flame axis.
2. The correlation is large and produces a contribution as mechanical work in the turbulent stress equations which cannot be ignored.
3. After several initial developments for simple flames, a fully three dimensional model for the $\overline{v_k'' \frac{\partial p}{\partial x_i}}$ correlation has been developed. It has been checked in the constant density limit for some classical flows and been found reasonable. It has been applied to a turbulent jet diffusion flame and found to bring excellent agreement between theory and experiment.
4. The theoretical model predicts an intense source of turbulence in premixed, one-dimensional flames, in accordance with experimental expectations.

The three dimensional model for $\overline{v_k'' \partial p / \partial x_i}$, which is the correlation which directly appears in turbulence stress equations, represents a marked departure from past practice. This model is currently under peer review, but is bound to stir up some controversy. Its success, however, in the diffusion flame and premixed flame problems attest to its usefulness. Direct measurement of this quantity has proved elusive, however, because a gradient is involved. The derivative taxes intrusive measurement methods. In order to counter this limitation a new experimental rig has been constructed and is currently under checkout. In this rig, LDV will be employed for velocity measurements, and it is hoped that laser Rayleigh scattering may be used for density determination. The pressure measurement, as always, will have to be made intrusively.

The following publications and presentations have resulted from this grant:

Refereed Publications

1. Strahle, W. C. and Chandran, S. B. S., "Pressure-Velocity Correlation in a Reactive Turbulent Flow," AIAA J 20, 129-135 (1982).
2. Strahle, W. C., "Estimation of Some Correlations in Reactive Turbulent Flows," Combustion Science and Technology (in press).
3. Strahle, W. C., "Duality, Dilatation, Diffusion and Dissipation in Reactive Turbulent Flows," 19th Symposium (International) on Combustion (in press).
4. Chandran, S. B. S. and Strahle, W. C., "The Effect of Pressure-Velocity Correlation in a Premixed, Planar, Turbulent Flame," Combustion and Flame (in review).
5. Strahle, W. C., "Velocity-Pressure Gradient Correlation in Turbulent Reactive Flows," Journal of Fluid Mechanics (in review).

Other Publications

1. Strahle, W. C., "Pressure Velocity Correlation in a Reactive Turbulent Flow," AIAA Paper No. 81-0108 (1981).
2. Komerath, N. M. and Strahle, W. C., "Measurement of the Pressure-Velocity Correlation in Turbulent Reactive Flows," AIAA Paper No. 83-0400 (to be printed in January, 1983).

Verbal presentations have been made of papers 1 and 3 under Refereed Publications above, where # 3 was an invited paper at the 19th Combustion Symposium in Haifa, Israel. Paper 2 under Other Publications will be presented at the 21st Aerospace Sciences Meeting. The senior author received his Ph.D under this program.